Measure: Commercial Thermal (G2c)

This measure analyzes mandating Solar Hot Water systems in for commercial buildings in Tucson. The analysis contemplates that commercial construction is substantially comprised of office and retail space. Calculations were completed assuming that all new construction water heaters are electric. Gas water heaters emit approximately 2/3 less CO_2e than their electric counterparts. Therefore, assuming the mandate replaces what would have been gas heaters, the already minute contribution of this measure would be further reduced.

Finally, due to the similarities with G2a Residential Thermal and the lack of material abatement potential, this analysis refers to that measure's write-up.

COT ARRA RFP Summary:

Emission reduction potential by 2020:	3,600 tCO_2e
Percentage of goal (2012):	Negligible
Percentage of goal (2020):	0.16%
Total annual average implementation costs:	NA
Entity that bears the costs of implementation:	Developer
Cost/Savings per tCO_2e:	\$138 / tCO_2e (assumed same as residential)
Net annual savings:	\$162 / system (assumed same as residential)
Entity that realizes the financial return:	Ratepayer
Equitability (progressive/regressive, income/revenue neutral, etc):	Only effects participants
Potential unintended consequences:	Possible increased water usage

Background information:

Solar hot water heaters utilize the sun's radiance to augment, or sometimes completely offset, the need for conventional water heating systems, which rely on fossil fuels via electricity and/or natural gas.

Aggressively incentivizing such systems in areas with abundant solar resources (such as Tucson) can lead to quantifiable GHG emission reductions with a net cost savings to the property owners. Payback periods range from 5 – 20 years (with The Solar Store estimates ranging from 3-7 years).[1]

Systems for commercial use in this analysis are considered to be the same as residential (eg, solar hot water systems taking the pace of conventional 40- to 50-gallon electric water heaters). This, in fact, would be the case for office and retail space due to the low hot water demand of such buildings. Therefore, the solar hot water systems envisioned in this analysis are comprised of one to two storage tanks and either active or passive solar collectors.[2] For more information on the mechanics of the three primary solar collectors as well as descriptions on active versus passive systems, please see the DOE Energy Savers website under Note (2). As opposed to educating on the mechanics and science, this analysis seeks to quantify the practical implementation of wide-use solar hot water systems in Tucson's new commercial construction, focusing on systems and energy savings that are most applicable to the region. Fortunately, a unique non-profit, the Solar Rating and Certification Corporation (SRCC), exists that certifies solar energy products and provides regional average annual energy savings.[3]

Under current, local incentive structures, there is a wide range of net installed costs among systems ranging from $4,000 to $7,000 depending on the type of system. Savings to the property owner can total $270 annually per solar heater installed from reduced energy use.

Business as usual:

Absent increased incentives and/or mandating solar hot water systems, this cost- and energy-saving measure could continue to go underutilized in the region. However, given the low abatement potential under the stipulated assumptions, this may not be a measure that the Climate Change Advisory Committee wants to pursue.

Description of Measure and Implementation Scenario:

The carbon and economic analysis assumes new commercial construction includes a mandate to install a solar hot water system that meets the industry OG-300 standard (also a TEP rebate requirement).

Whether or not additional financing is made available to property owners, this measure can be combined with the Community Climate Challenge (Measure E14). As the Climate Challenge is a public education campaign, marketing of the financial and energy savings need to be made clear to potential participants.

Has the Measure been implemented elsewhere and with what results?:

As outlined in all of the solar initiatives in this report (ie, residential thermal, residential PV, commercial PV, and solar hot water for pools), many rebates and incentives exist. For example, the TEP rebates for systems under 400,000 kWh equivalents match that of the residential rebates.[4] However, commercial hot water systems are simply not widely adopted at nearly any level. According the 165 pages of data on solar systems in the TEP service area, there are a total of (2) commercial hot water systems that utilized TEP rebates.[5] These systems are both "reserved" (ie, not installed), and the sizes are 200,643 kWh and 50,734 kWh (Endnote 5: pages 117 and 118 after being sorted by "Technology").

Energy/Emission analysis:

An SDHW system that meets the OG 300 standard can be expected to save 2,750 kWh of electricity per year.[6]

Description	***Input***	***Notes***
Expected annual electricity savings of a OG 3000 SDHW system in Tucson, AZ	2,750	kWh
COT electricity grid emissions factor	856	gCO_2e
Expected annual GHG savings per heater per year	2.4	tCO_2e
Commercial Construction Mandate		
Projected annual construction (sqft)	1,000,000	
Assumed QTY of buildings	50	
Assumed floors per building	3	
Square feet per FTE in commercial space	200	Average for retail and office space
Average hot water demand per FTE	10^7	

Using the above inputs, one 40- to 50-gallon conventional hot water heater could be used to serve each floor of the commercial space. The daily load calculates out to

approximately 330 gallons per day and that load is assumed to be uniformly spread throughout the day (7AM through 6PM). This totals approximately 150 new residential-sized solar hot water systems per year. Therefore, by 2020, the installed 1,500 systems would abate approximately 3,600 tCO_2e (or about 0.16% towards the 2020 goal).

Contribution analysis:		
COT 1990 Citywide GHG emissions (baseline):[8]	5,461,020	tCO_2e
MCPA 7% reduction target for COT:	5,078,749	
2012 BAU GHG emissions projection:	7,000,000	
2020 BAU GHG emissions projection:	7,343,141	
GHG emissions reduction to meet 7% goal (2012):	1,921,251	
GHG emissions reduction to meet 7% goal (2020):	2,264,392	
Residential Thermal- Increased Uptake via Incentives		
Contribution of G2d Residential Thermal (in 2020):	3,600	tCO_2e
2020 Contribution of G2d Residential Thermal:	0.16%	%

Economic analysis:

Description	***Input***	***Notes***
Annual electricity use for water heating per heater	2,925	kWh
Electricity costs per kWh	$0.08	Assumed to increase per this report's Energy Forecast
Capital cost of SDHW system	$7,000	
TEP Upfront Incentive (UFI)	$750	
TEP Performance Incentives (spread over 2 years)	$1,000	
Expected annual electricity savings	2,750	kWh
Federal rebate (30%)	$2,100	
State rebate (25%, max $1,000)	$1,000	
Cost after rebates	**$2,150**	
Life of analysis	20 years	

Based on the above inputs, the total savings to a property owner installing a solar hot water system has a net present value of $3,239 with a payback period under 10 years. It should be noted that installation in a commercial project may actually be more expensive that a home installation due to the length of plumbing to reach the roof required in a multi-story building.

- ***Savings*** per tCO_2e = ***$137.60 / tCO_2e***

Co-benefits:

Installation of solar hot water systems cushion ratepayers from fossil fuel rate spikes. Moreover, incentivizing accelerated uptake of clean technology can help spur the local economy and small businesses. It also helps in job creation based on the new demand for skilled and knowledgeable plumbers. Lastly, this Measure is synergetic with the Community Climate Challenge (Measure E14), and the two, among others, should be considered in concert.

Equitability:

Only effects participants.

Potential unintended consequences:

A potential negative unintended consequence is the increased use of water due to the availability of low cost hot water for domestic use.

General Note: All references retrieved October through December of 2010 unless otherwise noted.

Endnotes:

[1] http://www.solarstore.com/index.php/faqs/1-solar-faqs/21-incentives-what-is-the-payback-time-for-a-solar-water-heater-
[2] http://www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=12850
[3] Solar Rating and Certification Corporation: http://www.solar-rating.org/
[4] http://www.tep.com/Green/Business/Solar/spaceheating.asp
[5] http://arizonagoessolar.org/UtilityIncentives/TucsonElectricPower.aspx
[6] See TEP Green Energy- Solar Hot Water FAQs: http://www.tep.com/Green/Home/Solar/spaceheating.asp
[7] http://www.engineeringtoolbox.com/hot-water-consumption-person-d_91.html
[8] PAG Regional Greenhouse Gas Inventory- 2010